SILICON LABS' TS3004 VS. THE CMOS 555: DETERMINING LOWEST SUPPLY CURRENT FOR BATTERY-POWERED APPLICATIONS

1. Introduction

The 555 timer is the workhorse of ICs, with close to a billion of them manufactured every year. Introduced in 1972, the 555 is still in widespread use because of its ease of use, reasonable price, and good stability. It can be found in a wide variety of applications for oscillation, timing and pulse generation. But what if you need a timer IC for ultra-long life, low-frequency battery-powered/portable applications where a low supply current is a requirement? Is the CMOS555 timer your best option?

In this application note, we will compare the CMOS555 timer to the Silicon Labs' TS3004, a single-supply timer IC fully specified to operate over a supply voltage range of 1.55 V to 5.25 V while consuming 1.9 µA supply current. Requiring only a resistor to set the base output frequency (or output period) with a 50% duty cycle, the TS3004 timer/oscillator is compact, easy-to-use, and versatile.

2. TS3004 vs. the CMOS555

The TS3004 timer has an output frequency range of 0.0043 Hz to 300 kHz while maintaining a very low supply current. To demonstrate just how low the supply current is for the TS3004, we will compare the supply current consumption of the TS3004 to a CMOS555 timer side-by-side, with an output frequency of 1 Hz for both timers.

For this example, a Texas Instruments LMC555 is used as the CMOS version of the industry-standard 555 series of general-purpose timers. The LMC555 offers 1.5 V supply operating voltage and requires a single external resistor and a capacitor.

First, the output frequencies of both the TS3004 and CMOS555 were set to 1 Hz. To set the TS3004 output frequency to 1 Hz, the appropriate Frequency Divider Input setting must be selected as well as the necessary RSET resistance. The equation defining the FOUT frequency is found in the data sheet. As shown in Equation 1, FOUT is defined by only one external component, the RSET resistor.

$$FOUT = \frac{1.08 \times 10^{11}}{8^{FDIV2:0} \times R_{SET}}$$

Equation 1.

The Frequency Divider Input table in the data sheet shows that the correct setting to obtain a 1 Hz output frequency is 101, which is equivalent to 5. By substituting the appropriate value of 5 for FDIV2:0 into Equation [1] and using an output frequency of 1 Hz, the appropriate RSET value of 3.3 MΩ can be calculated.

To set the output frequency of the CMOS555 timer to 1 Hz, the oscillating frequency is defined by two external components, a "C" capacitor, and an "R_C" resistor. The equation defining the output frequency is found in the LMC555 data sheet.

$$f = \frac{1}{1.4 \times C \times R_C}$$

Equation 2.

Substituting the output frequency of 1 Hz and a standard capacitor value of 0.1 µF, the necessary R_C resistance of 7.14 MΩ can be calculated.

In setting the output frequency of both timers, the TS3004 offers an advantage because it only requires one component instead of the two external components required by the CMOS555.

To compare the supply currents of both timers side-by-side, a few supply voltages were applied while both supply currents were recorded. Table 1 displays the results.

Table 1. Supply Current per Supply Voltage

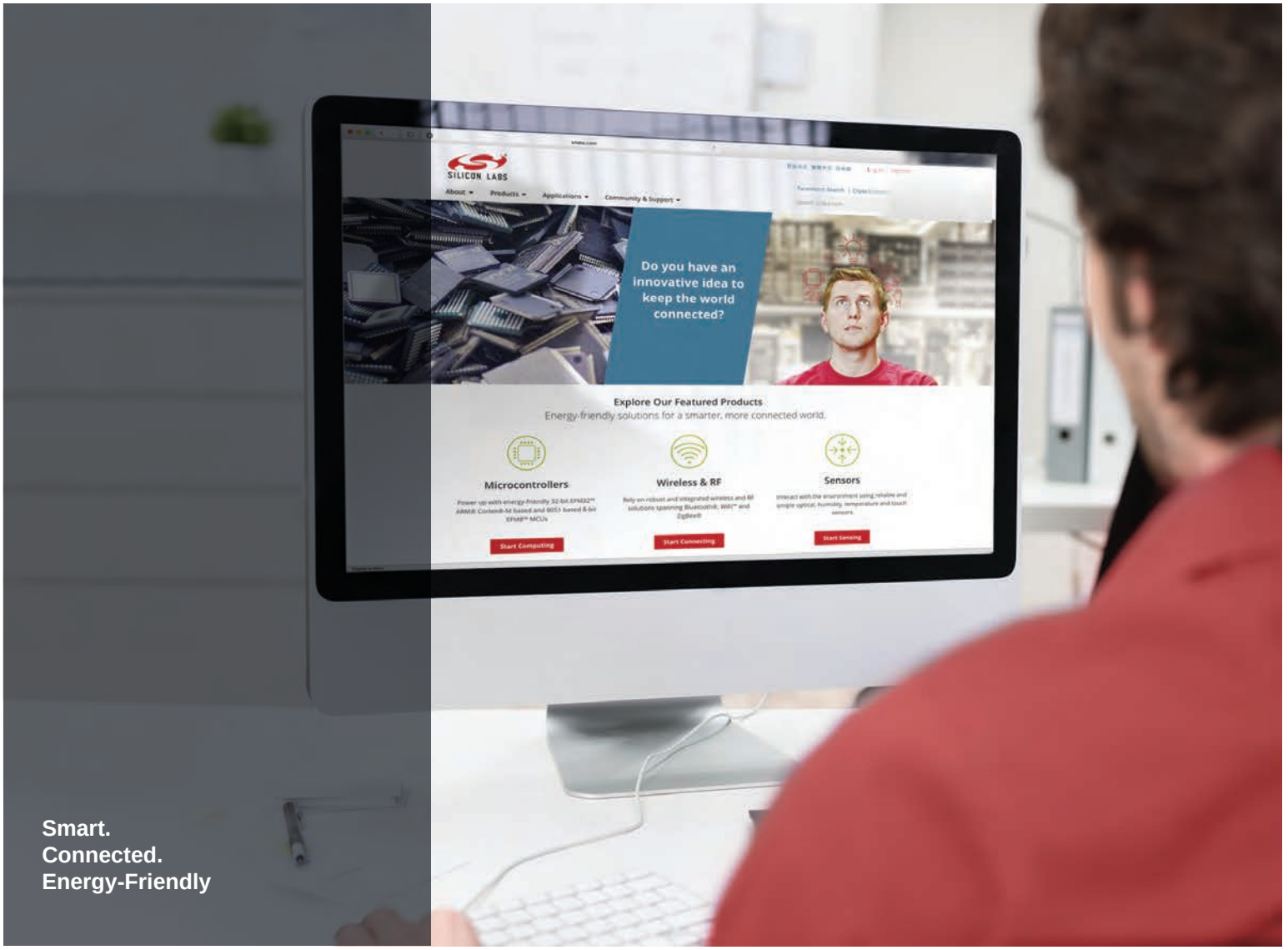
Supply Voltage	TS3004 Supply Current	CMOS555 Supply Current
1.5 V	1.9 µA	50 µA
2.5 V	2.0 µA	81 µA
3.3 V	2.3 µA	87 µA

As shown in Table 1, at 1.5 V, the TS3004 consumes a factor of 26 less supply current. With a 2.5 V supply, the TS3004 consumes a factor of 40 less supply current. With a 3.3 V supply, the TS3004 consumes a factor of 38 less supply current. In summary, the CMOS555 IC uses much more supply current than can be supported in battery or portable applications.

For all voltages within its supply range, the TS3004 saves a significant amount of supply current, which can help extend battery life in battery-powered applications. These applications include ultra-long life, low-frequency battery-powered/portable applications, such as micropower PWM control, pulse-position modulation control, clock generation, and sequential timing. The TS3004 can also be used as a low-parts-count micropower oscillator and compact replacement for crystal and ceramic oscillators.

For additional information, see the following:

- TS3004 timer IC
- TS3004 data sheet
- Silicon Labs' family of timer ICs



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